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THE DESIGN AND DEVELOPMENT OF AN INTERNET-BASED GRAPHICAL USER INTERFACE USING A COMMERCIAL DESIGN TOOL AND JAVA

Stephanie A. Myrick, Marlin L. Gendron, Maura C. Lohrenz, and Stephanie S. Edwards¹

Abstract. This paper describes the design and development of an Internet-hosted Graphical User Interface (GUI) to plan digital aeronautical chart coverages for cockpit moving-map displays by U.S. military aircraft mission planners, requirements officers, and aircrew. The GUI is a component of the Moving-Map Composer (MMC) software that has been developed by the Naval Research Laboratory at the Stennis Space Center (NRLSSC). MMC performs a wide variety of aeronautical chart planning functions, including the design and construction of chart images from user-specified data for use in naval mission planning systems and in-flight moving-map displays.

1. Introduction. X-Designer is a commercial GUI design tool (offered by Imperial Software Technology) that produces source code for the GUI designs created. X-Designer originally was used to produce an X Windows-based version of MMC and has proven to be an excellent tool for generating X Library (Xlib) and OSF/Motif source code. MMC is comprised of C functions and X-Designer generated code and is implemented as a standalone system on a Compaq Alpha workstation running OpenVMS. The main MMC GUI is shown in figure 1. A new version of MMC (due to be released in early 2001) will also run on a PC platform running Linux. Peripheral devices for performing optical disk operations are included as part of the system hardware configuration.

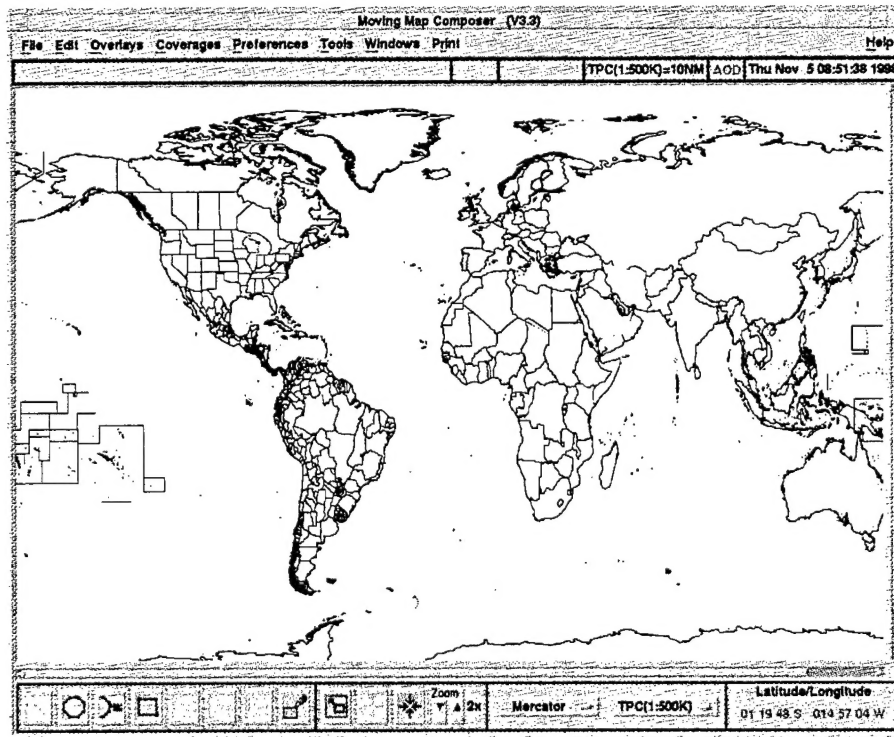


Figure 1. Main MMC GUI

Since its inception, MMC has undergone numerous software revisions to provide increased support to the fleet and, as a result, now is in greater demand. However, MMC is only available to those who have access to an Alpha workstation and the requisite peripheral devices, which are expensive to maintain and nearly obsolete in terms of CPU speed, memory, disk storage, etc. While the Linux

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PC version of MMC will help to alleviate obsolescence problems, many pilots and mission planners do not have access to these platforms, either. Therefore, NRLSSC scientists are starting to redesign MMC into a web-based system that would provide structural and platform independence. There are two principle benefits of this redesign: (1) As a web-based system, MMC will be accessible to a substantially greater number of users, primarily pilots and mission planners; (2) As a portable system, MMC no longer will be tied to any one hardware platform and will benefit from newer, faster hardware and peripherals as they become available.

2. Discussion. Software implementations using X-Windows, Java and C programming languages will meet these needs. NRLSSC scientists are utilizing the most recent version of X-Designer (v5.5) - which generates Java code - to generate the GUI portion of MMC in Java and OSF/Motif. Two companion papers being presented at this symposium address (1) the design and implementation of the Java Server portion of this MMC redesign, and (2) the design of Java-based moving-map simulations, on-line surveys and databases to solicit evaluations of future moving-map displays from pilots and mission planners stationed around the world.

The decision to continue utilizing X-Designer for software development was primarily based on product licensing and extensive familiarity with its use. Production costs were reduced since the license was current and scientists had previous experience with its use as a development tool. X-Designer also enabled GUI design and implementation to progress in a consistent manner by maintaining the design's "look and feel", maintaining the independence of lower level code, and streamlining individual programming styles. With personnel changes that are inherent in multi-year programs, it is essential to maintain control and consistency with programming techniques.

The following sections address the primary issues that are being during this transition to a web-based system: Section 2.1 covers design modification issues associated with using X-Designer for Java source code generation, and Section 2.2 covers MMC enhancements for web use.

2.1 Design Modifications. Modifications (e.g., additional buttons or windows) are quickly and easily made. Once a design is created or modified, the *Generation* feature of X-Designer is used to generate Java source code (including individual files for callback routines). These files are compiled, along with other existing low-level C functions, to create an executable application that is MMC (figure 2).

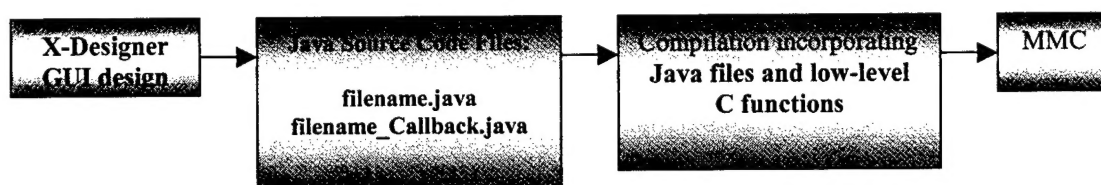


Figure 2. The transformation steps of a GUI design from its creation to its final form as an executable Java application.

To date, the only significant problem encountered generating Java source code (instead of X-windows) has been associated with the X-Designer Layout Manager and attachments. Specifically, some of the GUI component (i.e., widget) placement and size specifications have been set erroneously in the Java source code and required manual correction (figure 3). All manual corrections are documented within the source code. This problem appears to be limited to Java source code generation since the same design appears correct when implemented in X-Window source code. This may be one disadvantage of using X-Designer instead of other development tools that have been designed exclusively for generating Java source code.

However, these errors are easily corrected through modifications to the *FormLayoutConstraint* definitions and do not appear to be substantial impediments to the completion of this project.

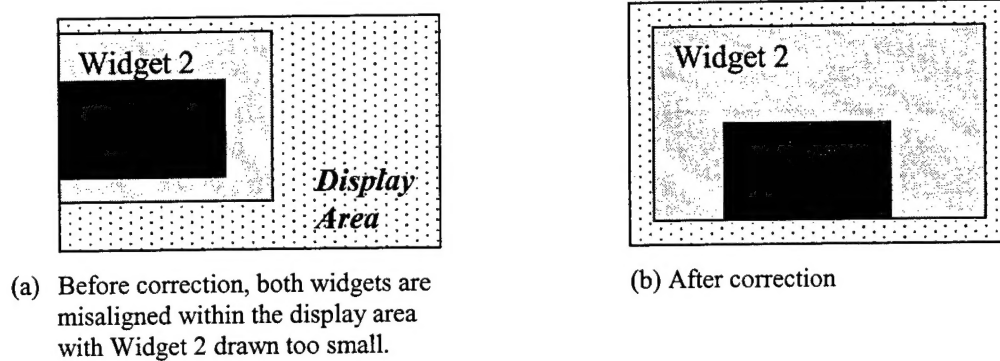


Figure 3. Widget placement and size attachments.

2.2 Development for Web use. MMC has been enhanced to serve in a client/server architecture on the Internet. The existing low-level C language code is robust and well tested. Therefore, in order to minimize software modifications and avoid introducing new bugs, only a few key changes are being made. These modifications primarily include file naming conventions, and file location operations. As an application, MMC now generates individual queries that belong to a set of ASCII-based query language commands that are being developed as part of this project. These commands are understood by both client and server and serve as their logical link (figure 4).

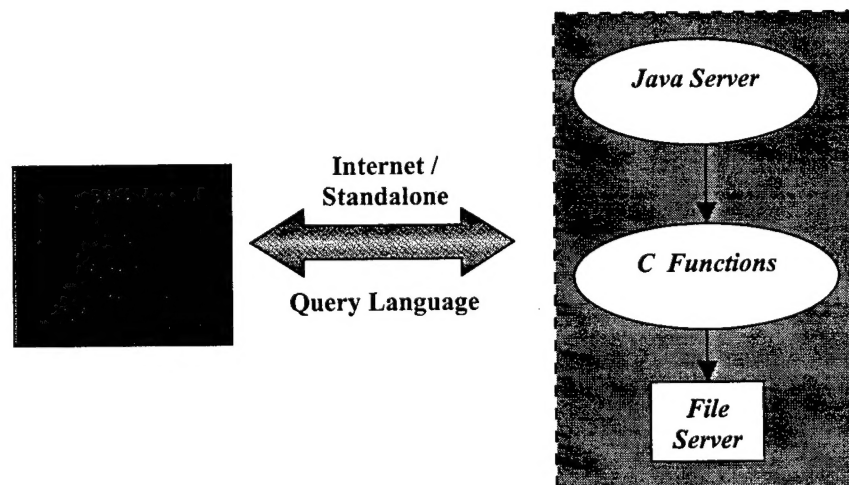


Figure 4. The Internet-based MMC GUI client application and its Java server.

For example, using the File Menu option to open a final composition (figure 5), generates the following query which is subsequently interpreted by the Java server:

```
build file[type=ascii] template[location=hd, name=all]
```

Queries are incorporated as part of the individual callback routines used within MMC. The appropriate C functions are then invoked to complete the tasks identified in the query. In the above example, a file selection menu is provided to obtain the name of a final composition and once opened, is available for use. With MMC available on the Internet, pilots and mission planners can design map

mission-specific compositions from their respective workplaces and maintain a library of chart coverages that are available for future use or may be modified as needed for other missions. With system hardware upgrades being transparent, these users will be able to rely on MMC, as a state of the art resource for their map display needs.

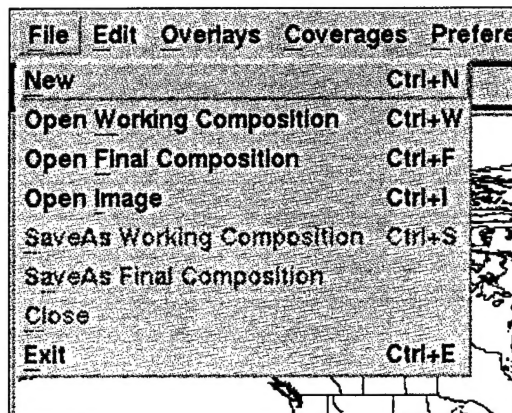


Figure 5. MMC File menu option

3. Summary. NRLSSC scientists have begun to redesign MMC into a web-based system that will provide structural and platform independence. As a web-based system, MMC will be accessible to a substantially greater number of users, primarily pilots and mission planners. As a portable system, MMC no longer will be tied to any one hardware platform and will benefit from newer, faster hardware and peripherals as they become available. X-Designer is being used in this effort since production costs can be reduced (due to the existence of current license agreements and in-house experience with its use as a development tool). X-Designer also offers the advantages of enabling GUI design and implementation to progress in a consistent manner by maintaining the design's "look and feel", maintaining the independence of lower level code, and streamlining individual programming styles. Primary issues that are being addressed during this transition to a web-based system include design modifications associated with using X-Designer for Java source code generation, and MMC enhancements for web use.

4. Acknowledgements. The Naval Air Systems Command funds this work in support of their AV-8B and F/A-18 aircraft programs.

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- [3] *X-Designer User's Guide*, Imperial Software Technology Limited, December 1999.
- [4] M. L. Gendron, S. S. Edwards, S.A. Myrick, M. Lohrenz, and M.E. Trenchard *The Design and Development of an Internet-based Graphical User Interface Using a Commercial Design Tool in Java*, Publication pending in the Proceedings of the Southern Conference on, Computing Hattiesburg, Mississippi, October 26-28, 2000.

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